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A GCM study of organic matter in marine aerosol and its potential contribution to cloud drop activation

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Abstract. With the global aerosol-climate model ECHAM5-HAM we investigate the potential influence of organic aerosol originating from the ocean on aerosol mass and chemical composition and the droplet concentration and size of marine clouds. We present sensitivity simulations in which the uptake of organic matter in the marine aerosol is prescribed for each aerosol mode with varying organic mass and mixing state, and with a geographical distribution and seasonality similar to the oceanic emission of dimethyl sulfide. Measurements of aerosol mass, aerosol chemical composition and cloud drop effective radius are used to assess the representativity of the model initializations. Good agreement with the measurements is obtained when organic matter is added to the Aitken, accumulation and coarse modes simultaneously. Representing marine organics in the model leads to higher cloud drop number concentrations and thus smaller cloud drop effective radii, and this improves the agreement with measurements. The mixing state of the organics and the other aerosol matter, i.e. internal or external depending on the formation process of aerosol organics, is an important factor for this. We estimate that globally about 75 Tg C yr^{-1} of organic matter from marine origin enters the aerosol phase, with comparable contributions from primary emissions and secondary organic aerosol formation.

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